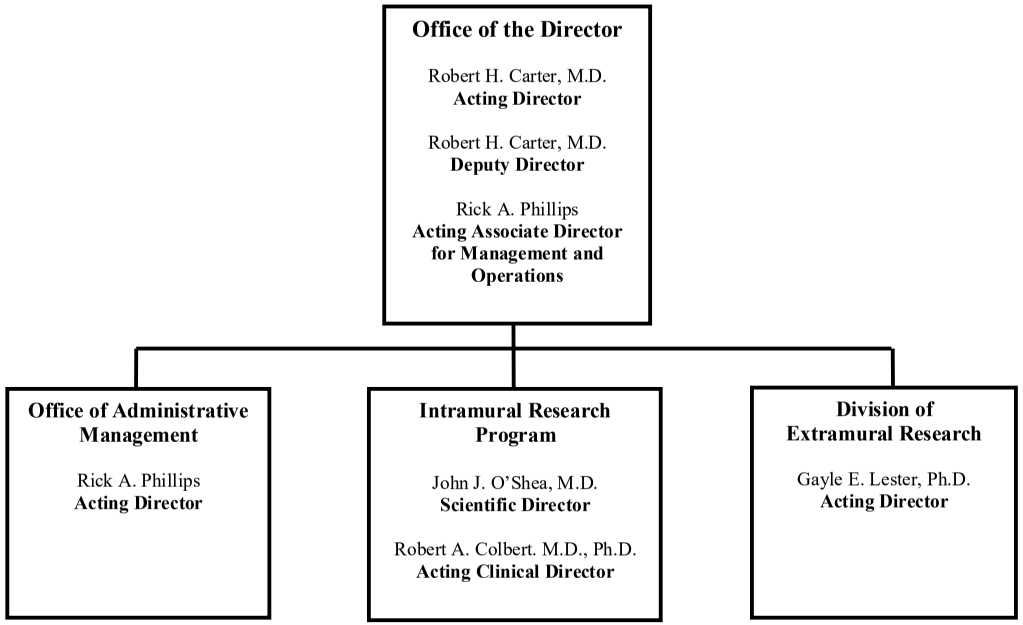
DEPARTMENT OF HEALTH AND HUMAN SERVICES

NATIONAL INSTITUTES OF HEALTH

National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS)

FY 2021 Budget — Page No.

National Institutes of Health
National Institute of Arthritis and Musculoskeletal and Skin Diseases
Organizational Chart



NATIONAL INSTITUTES OF HEALTH

National Institute of Arthritis and Musculoskeletal and Skin Diseases

For carrying out section 301 and title IV of the PHS Act with respect to arthritis and musculoskeletal and skin diseases, [$624,889,000]*$568,480,000*.

NATIONAL INSTITUTES OF HEALTH
National Institute of Arthritis and Musculoskeletal and Skin Diseases

Amounts Available for Obligation[1]

(Dollars in Thousands)

Source of Funding	FY 2019 Final	FY 2020 Enacted	FY 2021 President's Budget
Appropriation	$605,065	$624,889	$568,480
Mandatory Appropriation: (non-add)			
Type 1 Diabetes	*(0)*	*(0)*	*(0)*
Other Mandatory financing	*(0)*	*(0)*	*(0)*
Rescission	0	0	0
Sequestration	0	0	0
Secretary's Transfer	-2,078	0	0
Subtotal, adjusted appropriation	$602,987	$624,889	$568,480
OAR HIV/AIDS Transfers	-69	0	0
HEAL Transfer from NINDS	0	0	0
Subtotal, adjusted budget authority	$602,918	$624,889	$568,480
Unobligated balance, start of year	0	0	0
Unobligated balance, end of year	0	0	0
Subtotal, adjusted budget authority	$602,918	$624,889	$568,480
Unobligated balance lapsing	-11	0	0
Total obligations	$602,907	$624,889	$568,480

[1] Excludes the following amounts (in thousands) for reimbursable activities carried out by this account:
FY 2019 - $6,712 FY 2020 - $6,933 FY 2021 - $6,309

NATIONAL INSTITUTES OF HEALTH
National Institute of Arthritis and Musculoskeletal and Skin Diseases

Budget Mechanism - Total[1]

(Dollars in Thousands)

MECHANISM	FY 2019 Final		FY 2020 Enacted		FY 2021 President's Budget		FY 2021 +/- FY 2020 Enacted	
	No.	Amount	No.	Amount	No.	Amount	No.	Amount
Research Projects:								
Noncompeting	730	$286,711	750	$307,577	736	$280,009	-14	-$27,568
Administrative Supplements	*(35)*	2,218	*(39)*	4,221	*(20)*	2,218	*(-19)*	-2,003
Competing:								
Renewal	24	12,077	29	10,715	26	8,885	-3	-1,830
New	247	88,553	211	78,567	188	65,152	-23	-13,415
Supplements	0	0	0	0	0	0	0	0
Subtotal, Competing	271	$100,630	240	$89,282	214	$74,037	-26	-$15,245
Subtotal, RPGs	1,001	$389,559	990	$401,080	950	$356,264	-40	-$44,816
SBIR/STTR	44	18,232	47	18,882	46	17,036	-1	-1,846
Research Project Grants	1,045	$407,791	1,037	$419,962	996	$373,300	-41	-$46,662
Research Centers:								
Specialized/Comprehensive	41	$42,859	43	$45,305	43	$42,555	0	-$2,750
Clinical Research	0	0	0	0	0	0	0	0
Biotechnology	0	0	0	0	0	0	0	0
Comparative Medicine	0	50	0	50	0	50	0	0
Research Centers in Minority Institutions	0	0	0	0	0	0	0	0
Research Centers	41	$42,909	43	$45,355	43	$42,605	0	-$2,750
Other Research:								
Research Careers	138	$20,740	138	$20,740	138	$20,740	0	$0
Cancer Education	0	0	0	0	0	0	0	0
Cooperative Clinical Research	0	0	0	0	0	0	0	0
Biomedical Research Support	0	0	0	0	0	0	0	0
Minority Biomedical Research Support	0	250	0	250	0	250	0	0
Other	33	2,604	33	2,604	32	2,547	-1	-57
Other Research	171	$23,593	171	$23,594	170	$23,537	-1	-$57
Total Research Grants	1,257	$474,293	1,251	$488,911	1,209	$439,442	-42	-$49,469
Ruth L Kirchstein Training Awards:	FTTPs		FTTPs		FTTPs		FTTPs	
Individual Awards	65	$3,107	64	$3,157	64	$3,157	0	$0
Institutional Awards	213	12,684	215	13,088	215	13,088	0	0
Total Research Training	278	$15,791	279	$16,245	279	$16,245	0	$0
Research & Develop. Contracts	41	$16,939	42	$20,023	40	$20,023	-2	$0
(SBIR/STTR) (non-add)	*(0)*	*(196)*	*(0)*	*(204)*	*(0)*	*(194)*	*(0)*	*(-10)*
Intramural Research	117	62,580	138	64,997	138	59,792	0	-5,204
Res. Management & Support	100	33,315	100	34,714	100	32,978	0	-1,736
Res. Management & Support (SBIR Admin) (non-add)	*(0)*	*(0)*	*(0)*	*(0)*	*(0)*	*(0)*	*(0)*	*(0)*
Construction		0		0		0		0
Buildings and Facilities		0		0		0		0
Total, NIAMS	217	$602,918	238	$624,889	238	$568,480	0	-$56,409

[1] All items in italics and brackets are non-add entries.

Major Changes in the Fiscal Year 2021 President's Budget Request

Major changes by budget mechanism and/or budget activity detail are briefly described below. Note that there may be overlap between budget mechanism and activity detail, and these highlights will not sum to the total change for the FY 2021 President's Budget request for NIAMS, which is $568.5 million, a decrease of $56.4 million from the FY 2020 Enacted level. The FY 2021 President's Budget reflects the Administration's fiscal policy goals for the Federal Government. Within that framework, NIAMS will pursue its highest research priorities through strategic investments and careful stewardship of appropriated funds.

Research Project Grants (RPGs) (-$46.7 million; total $373.3 million):
Funding for non-competing RPGs will be reduced due to a smaller number of grants planned for non-competing awards in FY 2021, along with a 7.0 percent reduction in the level of non-competing awards from their full funding level. Competing RPGs are expected to decrease by 10.8 percent or 26 grants compared to the FY 2020 Enacted level of 240 awards, and the amount to support competing awards will be reduced by $15.2 million from FY 2020. These reductions are distributed across all programmatic areas and basic, translational or clinical research. NIAMS continues to place a priority on support to early-stage investigators.

Research Centers (-$2.7 million; total $42.6 million):
NIAMS will support a total of 43 research center awards. NIAMS will reduce funding for non-competing Center awards by 7.0 percent which is a $2.0 million decrease from the full funding level. The reductions are distributed across all programmatic areas.

Intramural Research (-$5.2 million; total $59.8 million):
NIAMS will reduce funding for intramural research by 8.0 percent. These reductions are distributed across all programmatic areas and basic, translational or clinical research.

NATIONAL INSTITUTES OF HEALTH
National Institute of Arthritis and Musculoskeletal and Skin Diseases

Summary of Changes

(Dollars in Thousands)

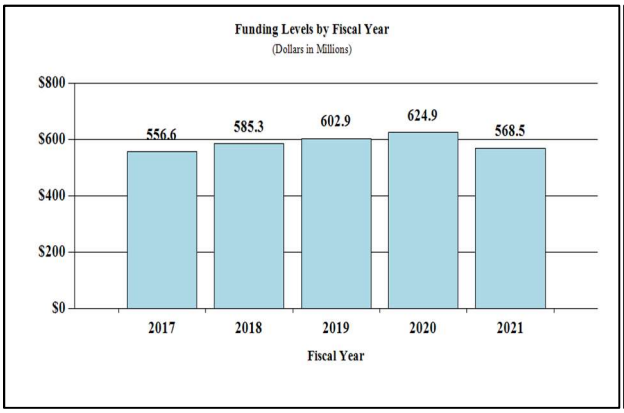
FY 2020 Enacted	$624,889
FY 2021 President's Budget	$568,480
Net change	-$56,409

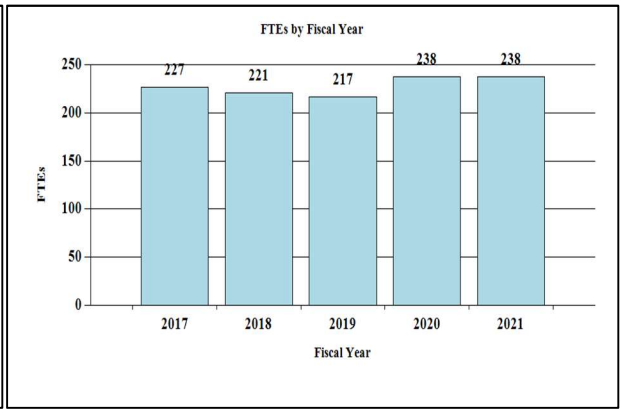
CHANGES	FY 2021 President's Budget FTEs	FY 2021 President's Budget Budget Authority	Change from FY 2020 Enacted FTEs	Change from FY 2020 Enacted Budget Authority
A. Built-in:				
1. Intramural Research:				
a. Annualization of January 2020 pay increase & benefits		$23,205		$149
b. January FY 2021 pay increase & benefits		23,205		353
c. Paid days adjustment		23,205		-87
d. Differences attributable to change in FTE		23,205		0
e. Payment for centrally furnished services		11,045		-68
f. Cost of laboratory supplies, materials, other expenses, and non-recurring costs		25,543		-62
Subtotal				$285
2. Research Management and Support:				
a. Annualization of January 2020 pay increase & benefits		$17,872		$114
b. January FY 2021 pay increase & benefits		17,872		275
c. Paid days adjustment		17,872		-67
d. Differences attributable to change in FTE		17,872		0
e. Payment for centrally furnished services		3,751		-197
f. Cost of laboratory supplies, materials, other expenses, and non-recurring costs		11,355		-59
Subtotal				$66
Subtotal, Built-in				$351

CHANGES	FY 2021 President's Budget No.	FY 2021 President's Budget Amount	Change from FY 2020 Enacted No.	Change from FY 2020 Enacted Amount
B. Program:				
1. Research Project Grants:				
a. Noncompeting	736	$282,227	-14	-$29,571
b. Competing	214	74,037	-26	-15,245
c. SBIR/STTR	46	17,036	-1	-1,846
Subtotal, RPGs	996	$373,300	-41	-$46,662
2. Research Centers	43	$42,605	0	-$2,750
3. Other Research	170	23,537	-1	-57
4. Research Training	279	16,245	0	0
5. Research and development contracts	40	20,023	-2	0
Subtotal, Extramural		$475,710		-$49,469
	FTEs		FTEs	
6. Intramural Research	138	$59,792	0	-$5,490
7. Research Management and Support	100	32,978	0	-1,801
8. Construction		0		0
9. Buildings and Facilities		0		0
Subtotal, Program	238	$568,480	0	-$56,760
Total changes				-$56,409

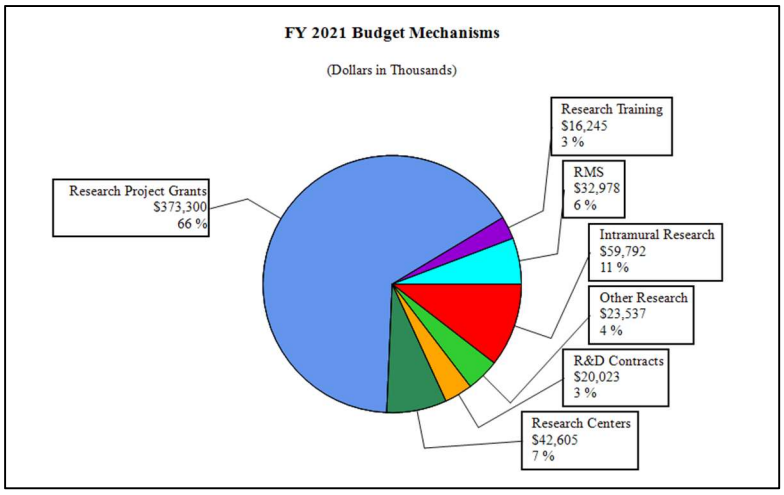
Fiscal Year 2021 Budget Graphs

History of Budget Authority and FTEs:

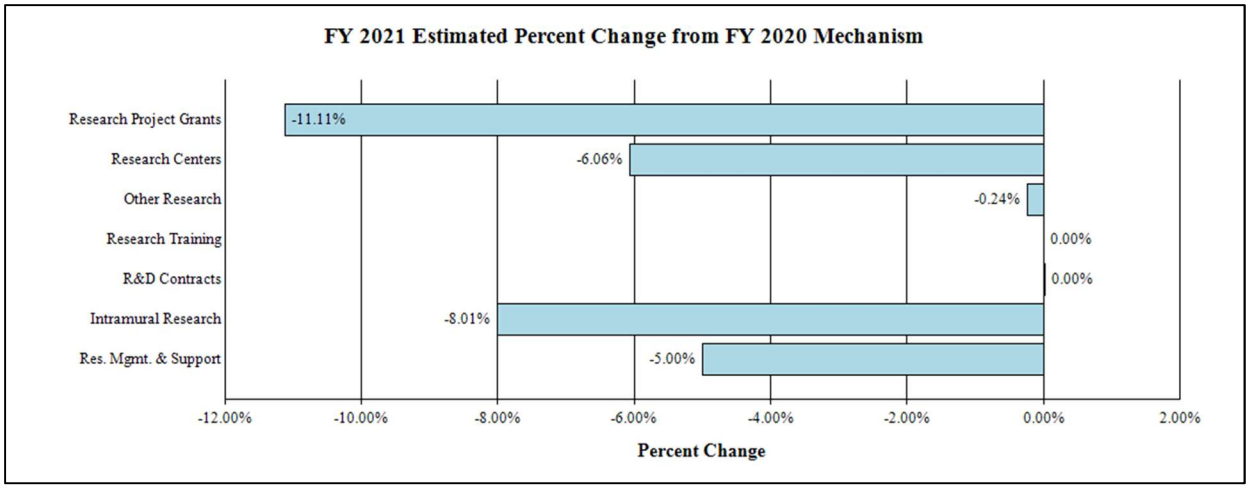




Distribution by Mechanism:



Change by Selected Mechanism:



NATIONAL INSTITUTES OF HEALTH
National Institute of Arthritis and Musculoskeletal and Skin Diseases

Budget Authority by Activity[1]

(Dollars in Thousands)

	FY 2019 Final		FY 2020 Enacted		FY 2021 President's Budget		FY 2021 +/- FY2020	
Extramural Research	**FTE**	**Amount**	**FTE**	**Amount**	**FTE**	**Amount**	**FTE**	**Amount**
Detail								
Systemic Rheumatic and Autoimmune Diseases		$103,183		$106,878		$96,811		-$10,067
Skin Biology and Diseases		98,955		102,498		92,843		-9,655
Muscle Biology and Diseases		75,128		77,818		70,488		-7,330
Joint Biology and Diseases and Orthopaedics		147,050		152,316		137,968		-14,347
Bone Biology and Diseases		82,707		85,669		77,599		-8,070
Subtotal, Extramural		**$507,023**		**$525,179**		**$475,710**		**-$49,469**
Intramural Research	**117**	**$62,580**	**138**	**$64,997**	**138**	**$59,792**	**0**	**-$5,204**
Research Management & Support	**100**	**$33,315**	**100**	**$34,714**	**100**	**$32,978**	**0**	**-$1,736**
TOTAL	**217**	**$602,918**	**238**	**$624,889**	**238**	**$568,480**	**0**	**-$56,409**

[1] Includes FTEs whose payroll obligations are supported by the NIH Common Fund.

NATIONAL INSTITUTES OF HEALTH
National Institute of Arthritis and Musculoskeletal and Skin Diseases

Authorizing Legislation

	PHS Act/ Other Citation	U.S. Code Citation	2020 Amount Authorized	FY 2020 Enacted	2021 Amount Authorized	FY 2021 President's Budget
Research and Investigation	Section 301	42§241	Indefinite	$624,889,000	Indefinite	$568,480,000
National Institute of Arthritis and Musculoskeletal and Skin Diseases	Section 401(a)	42§281	Indefinite		Indefinite	
Total, Budget Authority				$624,889,000		$568,480,000

NATIONAL INSTITUTES OF HEALTH
National Institute of Arthritis and Musculoskeletal and Skin Diseases

Appropriations History

Fiscal Year	Budget Estimate to Congress	House Allowance	Senate Allowance	Appropriation
2012	$547,891,000	$547,891,000	$528,332,000	$536,801,000
Rescission				$1,014,454
2013	$535,610,000		$537,233,000	$535,786,446
Rescission				$1,071,573
Sequestration				($26,892,795)
2014	$540,993,000		$537,398,000	$520,053,000
Rescission				$0
2015	$520,189,000			$521,665,000
Rescission				$0
2016	$533,232,000	$528,137,000	$544,274,000	$542,141,000
Rescission				$0
2017[1]	$541,662,000	$555,181,000	$564,131,000	$557,851,000
Rescission				$0
2018	$417,898,000	$566,515,000	$576,178,000	$586,661,000
Rescission				$0
2019	$545,494,000	$593,663,000	$605,383,000	$605,065,000
Rescission				$0
2020	$520,829,000	$634,637,000	$637,097,000	$624,889,000
Rescission				$0
2021	$568,480,000			

[1] Budget Estimate to Congress includes mandatory financing.

Justification of Budget Request

National Institute of Arthritis and Musculoskeletal and Skin Diseases

Authorizing Legislation: Section 301 and title IV of the Public Health Service Act, as amended.

Budget Authority (BA):

	FY 2019 Final	FY 2020 Enacted	FY 2021 President's Budget	FY 2021 +/- FY 2020
BA	$602,918,000	$624,889,000	$568,480,000	-56,409,000
FTE	217	238	238	0

Program funds are allocated as follows: Competitive Grants/Cooperative Agreements; Contracts; Direct Federal/Intramural and Other.

Director's Overview

The National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS) is the primary Federal agency responsible for supporting biomedical research on diseases of the bones, joints, muscles, and skin. Arthritis and musculoskeletal and skin conditions of all types affect people of all ages and of all racial and ethnic backgrounds. Combined, they afflict tens of millions of Americans, cause tremendous human suffering, and cost the U.S. economy billions of dollars in health care costs and lost productivity. For instance, the 2017 Global Burden of Disease survey found that low back pain was the leading cause of disability in the United States, as measured in years lived with disability (YLDs).[1] Other musculoskeletal diseases, a category that includes many systemic rheumatic, bone, muscle, and joint diseases, was among the top 10 causes of YLDs. The Centers for Disease Control and Prevention (CDC) estimate that 59.0 million adults in the United States have arthritis,[2] and a recent study suggests that this may be an underestimate.[3] As the U.S. population ages, the prevalence of arthritis and its associated costs is expected to grow.

To help address the growing health needs of the American public, NIAMS conducts and supports a broad portfolio of biomedical and behavioral research activities into the causes, treatment, and prevention of arthritis and musculoskeletal and skin diseases. These investments range from basic studies to enable comprehensive understanding of the molecular mechanisms underlying disease processes, to preclinical research in model systems, to translational studies that bridge the bench and bedside, to clinical and epidemiological research.

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[1] The Institute for Health Metrics and Evaluation (IHME). (2017). United States. Available at http://www.healthdata.org/united-states

[2] Centers for Disease Control and Prevention (CDC). National Center for Health Statistics. (2018). Arthritis. Available at https://www.cdc.gov/nchs/fastats/arthritis.htm

[3] Jafarzadeh SR, et al. *Arthritis Rheumatol*. 2018. PMID: 29178176. Available at https://www.ncbi.nlm.nih.gov/pubmed/29178176

In the fall of 2019, NIAMS released a new Strategic Plan for Fiscal Years (FYs) 2020-2024 to communicate the Institute's perspective on its mission areas, including the potential of current research and the Institute's vision for how work over the next 5 years may lead to meaningful improvements in human health. Importantly, NIAMS continues to value and support meritorious investigator-initiated research ideas while embracing opportunities for collaborations with other NIH components, advocacy organizations, and industry to fund larger scale, team science approaches. NIAMS's approach will foster a rich and adaptable research environment that enables scientists to capitalize on opportunities as they arise and stimulate new areas that are unexpected and transformative. Thus, this Plan should be viewed not as directions to a defined destination, but rather as a point of departure for exploration to spark unanticipated discoveries. It will be a resource to encourage creative approaches for generating the scientific discoveries that will ultimately improve the health of the American public.

As the new Plan provides vision for the future, it is important to reflect upon the advances in human health that have been made possible through biomedical research. Indeed, progress in understanding diseases today has been possible through NIAMS' long-standing commitment to promote the unexpected and allow researchers to propose their best, and most innovative, ideas. Today, biomedical science is at the cusp of significant changes in the way diseases are diagnosed, evaluated, and treated. In NIAMS mission areas, the striking progress that has been made in the lives of patients is illustrated here through the two disease groups – the muscular dystrophies and the autoimmune diseases rheumatoid arthritis and lupus.

Muscular Dystrophy – Past, Present, and Promise

The muscular dystrophies are a group of more than 30 genetic diseases characterized by progressive degeneration of skeletal muscles. Many dystrophies also affect other organ systems, such as the heart, brain, blood vessels, and stomach and intestines. Some forms occur in infancy or childhood, while others typically appear in middle age or later.

Twenty to 30 years ago, researchers around the world were searching for the genes responsible for these diseases. Through research sponsored by NIAMS and other Institutes, the specific genetic anomaly for many forms of muscular dystrophy have been identified. This seminal work had led to additional discoveries into these diseases' molecular mechanisms and provided the basis for strategies to advance clinical research and develop potential treatments.

For example, NIAMS-supported researchers have contributed greatly over the past decade to the understanding of the molecular events leading to facioscapulohumeral muscular dystrophy (FSHD). FSHD is caused by the inadvertent expression of a gene that is normally silent in adult tissues. With support from NIAMS, other Institutes, and private funders, researchers discovered that FSHD type 1 is caused by the shortening of a region of chromosome 4 that contains a gene called *DUX4*. This shortening alters the physical properties of the DNA so that the gene is more readily expressed. Further work showed that if this shortened chromosome coexists with a specific DNA sequence adjacent to *DUX4*, then an individual will show the signs of FSHD type

1. Additional mutations on a different chromosome have also been identified that influence *DUX4* expression in a closely related form of muscular dystrophy, FSHD type 2, and that influence disease severity in FSHD type 1.

As our knowledge of the mechanisms underlying FSHD and other muscular dystrophies has increased, so has therapeutic development and private industry investment to bring therapies to patients. However, the muscular dystrophies present several challenges that complicate clinical trial design and execution. Some muscular dystrophies, such as FSHD and Duchenne muscular dystrophy (DMD), can progress variably. In many cases, functional declines progress over years, making clinical outcomes difficult to detect in the relatively short duration of a clinical trial. New approaches are needed to determine if therapeutic interventions are slowing, halting, or reversing an individual patient's disease course.

One challenge stems from the belief that intervening at an earlier age when there is more muscle to save will be most beneficial, especially for DMD. Clinical trials in young children can be difficult, however, because many commonly used functional outcome assessments do not work well in this age group. Researchers supported by NIAMS are addressing these challenges by developing sensitive imaging methods. NIAMS-supported researchers using magnetic resonance imaging (MRI) found markers of disease progression in the limbs of young boys that can detect even subtle changes in response to therapy in a relatively short period. This imaging method is so robust that it is now being used in several trials by pharmaceutical companies and academic researchers around the world. Researchers working on MRI for DMD helped pioneer a path for other dystrophies including FSHD.

In addition, FSHD investigators are using MRI to identify muscles that have active disease, and then confirming the MRI information by examining gene expression changes characteristic of FSHD. Because only some muscles in FSHD patients are degenerating at any time, being able to focus specifically on actively affected muscles and using gene expression changes as a marker for therapeutic efficacy will improve the likelihood of finding effective therapies.

One of the most promising therapeutic approaches being pursued for the muscular dystrophies is the targeting of the genetic causes of the diseases themselves. In 2016, the first therapy for DMD approved by the Food and Drug Administration (FDA) used an approach called exon skipping, where small molecules similar to DNA are used to coax cells into "skipping over" mutations in a person's DNA that cause disease. With encouragement from patient advocates, a group of NIAMS-funded investigators adapted exon skipping methods being developed for DMD to another form of muscular dystrophy, limb-girdle muscular dystrophy type 2C. Preliminary results in fruit flies, mice, and cell cultures were promising and this work is ongoing with support from other NIH Institutes.

Other investigators are pursuing a type of gene therapy where a normal copy of a gene is transferred to a patient, often using a virus. NIAMS-funded investigators are partnering with industry on clinical studies that use this approach. In one case, NIAMS-supported investigators

developed a miniaturized version of the dystrophin gene, packaged it in a viral vector, and completed sufficient preclinical testing. This Federally supported work caught the interest of a company that is now using the approach in a clinical trial for DMD patients. Meanwhile, two other ongoing NIAMS-funded muscular dystrophy gene therapy clinical trials are transitioning to industry support; one is for DMD, and the other is for limb-girdle muscular dystrophy type 2D. Still other NIAMS investigators are continuing to explore novel gene therapy approaches, such as the delivery of surrogate genes, that could be beneficial for DMD and some congenital muscular dystrophies.

Looking to the future, NIAMS will continue to encourage investigators to partner with industry to conduct the larger, more costly trials that are necessary before therapies can be safely brought to the clinic. NIAMS also will continue to support a balanced research portfolio of basic, preclinical, and clinical studies across many forms of the muscular dystrophies as advances in one dystrophy often carryover to inform other dystrophies and myopathies. With the clinical and preclinical advances emerging today, and a broad and growing foundation of basic insights from which to build, it is likely that some patients living today will have more therapeutic options and potentially life-enhancing treatments for their disease made possible in part by NIAMS-funded research.

Rheumatoid Arthritis and Lupus Research – A Window into Autoimmune Diseases

Autoimmune diseases are a family of over 80 related chronic conditions caused by abnormalities in the immune system that lead the body to attack its own healthy tissues and organs. Individuals with autoimmune disease often experience debilitating symptoms which, in some cases, can be life-threatening. Although autoimmune diseases affect people of all ages and backgrounds, many of them disproportionately affect women and certain racial and ethnic groups. Over many decades, research supported by the NIH has provided insights into autoimmunity and identified key similarities among autoimmune conditions, such as the presence of antibodies that recognize normal tissues called autoantibodies, immune cell defects, inflammation, and organ damage. While autoimmune diseases may differ in the immune pathways and organs they affect, the underlying similarities between them means that research on one autoimmune disease can potentially provide critical information about others. For example, research on rheumatoid arthritis and lupus has helped to provide a window into the molecular mechanisms and possible treatment of autoimmunity.

For many years, NIAMS and other Institutes at NIH have supported studies to understand the causes of autoimmune diseases and to apply this knowledge to the development of new therapies. Research identified the cells, proteins (cytokines), and cellular receptors involved in immune signaling pathways, and scientists searched for key molecules that could be targeted to treat rheumatoid arthritis and lupus. By the late 1990s, this research led to the development of a new class of drugs called biologics. These genetically engineered proteins could specifically target individual components of the immune system known to play a role in rheumatoid arthritis or lupus. For example, scientists found that tumor necrosis factor alpha (TNF-alpha), a molecule

that helps to regulate the immune system, contributes significantly to inflammation and joint destruction in animals and people with arthritis. Several TNF-alpha inhibitors were developed, tested, and subsequently approved by the Food and Drug Administration (FDA) for the treatment of rheumatoid arthritis and other autoimmune conditions. These drugs, called biologics, were a major advance and dramatically improved patient outcomes by reducing symptoms, increasing energy, and decreasing inflammation.

Since the early 2000s, newer treatments, such as the Jak inhibitors, have offered additional options for patients. Like the biologics, the Jak inhibitors target a specific immune pathway. However, they are a synthetic drug and available in pill form, whereas biologics must be administered via intravenous infusion or injection.

Despite the progress achieved with the use of targeted therapies, there are still unmet needs for more effective and safer treatments. Some patients respond only partially to current treatment regiments. Furthermore, although the targeted drugs affect specific immune pathways, they can still increase a patient's risk of infections.

One way NIAMS and the National Institute of Allergy and Infectious Diseases (NIAID) are addressing the challenge of developing new and better therapies for rheumatoid arthritis and lupus is through a public-private partnership with pharmaceutical companies and non-profit organizations. The major goal of this collaboration, called the Accelerating Medicines Partnership (AMP) in Rheumatoid Arthritis and Lupus, is to apply new tools and approaches to deepen our understanding of these conditions. The AMP is expected to help doctors predict which existing drugs will work best for which patients and to develop new targeted therapies, including treatments that do not broadly perturb the immune system. This new approach differs from past efforts in several important ways. First, rather than using animal models, the partnership is collecting and analyzing human samples that are affected by the disease, including joint tissue from rheumatoid arthritis patients and kidney and skin tissues from individuals with lupus. This allows researchers to study the human immune cells in these disease tissues and to gain a much better understanding of how non-immune cells in the disease tissues may play a role. Second, in recent years many new technologies have emerged that enable researchers to study the activity of individual cells. Earlier research methods only allowed for analysis of very large numbers of cells, essentially providing an average from many kinds of cells. When the AMP began in in 2014, new tools were emerging to allow researchers to spot changes in single cells or very small populations of cells. The new techniques enabled scientists to explore whether relatively rare cells or cell populations, which would have been difficult to study in the past, might contribute to rheumatoid arthritis and lupus. Finally, the revolution in information technology has provided the computational tools needed to integrate clinical information from patients with data from laboratory analyses of their cells and tissue samples, thereby creating a comprehensive model of disease.

The AMP and related projects are already providing potential new directions for treating rheumatoid arthritis. Several recent studies of rheumatoid arthritis have examined fibroblast-like

synoviocytes, a specialized cell type located in joints, as new targets for therapy or as sources of biomarkers to enable precision therapy. In lupus, treatments are needed that address the most severe forms of the disease, such as damage to kidneys and the brain. By looking at the kidney tissue through the AMP and other studies, researchers are improving understanding of how cells in the kidneys might contribute to disease. Finally, current efforts with both animal models and humans are exploring the biological basis of neuropsychiatric disease in lupus patients.

The knowledge gained from the AMP and other efforts is expected to enhance researchers' ability to divide patients into groups with similar molecular characteristics. This potentially will improve clinical trial designs by ensuring that participants are similar in meaningful ways. For example, researchers could evaluate the efficacy of drugs that target a specific cytokine only in individuals where that cytokine appears to play a role in the disease. In addition, information about an individual patient's autoantibodies, family history, or early clinical symptoms may allow researchers to identify individuals who might benefit from preventive approaches and to inform clinical trial designs to prevent the development or worsening of disease. Ultimately, the data collected through AMP and other research efforts may allow clinicians to reverse autoimmune diseases, such as rheumatoid arthritis and lupus, or prevent them.

Programs Supported in FY 2015 – FY 2019

From FY 2015 to FY 2019, the NIAMS appropriation increased from $521.7 million to $605.1 million, an increase of nearly 16 percent. During this same window, NIAMS saw an increase in the number of research applications as well as an increase in the average requested budgets of those applications. NIAMS maintained a 12th percentile payline for competing research project grants (e.g., R01). In alignment with NIAMS priorities to support early-stage investigators (ESIs), NIAMS has extended the R01 payline for early stage investigators from the 17th percentile in FY 2015 to the 22nd percentile in FY 2019. NIAMS will continue to balance support for both established researchers and ESIs to ensure a healthy mix of new awards and out-year commitments.

In addition, NIAMS has supported initiatives specifically targeted to support innovative, potentially paradigm-shifting research efforts. The NIAMS Research Innovations for Scientific Knowledge, or RISK, program is designed to promote scientific innovation by encouraging the submission of projects that are considered too risky, controversial, or unconventional for other programs and seeks to address this challenge through revised emphasis during the peer review process. NIAMS assessed the first round of RISK applications and found that overall funding success appeared to correlate with innovation, suggesting that the program is meeting its goals. This informed continuation of the program and re-issue of new RISK funding opportunities, which are expected to be funded in FY 2020.

Furthermore, NIAMS initiated and renewed the Supplements to Advance Research (STAR) program since FY 2015. It is designed to support early-career investigators as they work to transition from a single project to a research program. The STAR program provides substantial

supplemental funding to NIAMS investigators who have successfully renewed a first NIAMS-supported R01 that was received with Early Stage Investigator (ESI) status. The additional resources allow the principal investigators to propose challenging, creative, and innovative endeavors that if successful, would broaden the scope of their research program. Between FY 2015 and FY 2018, sixteen STAR awards were made to investigators and cover a broad range of scientific areas from across the NIAMS mission. The current funding opportunity will continue through FY 2021.

NIAMS led the development of the NIH Back Pain Consortium (BACPAC) Research Program, a part of the NIH Helping to End Addiction Long-term Initiative, or NIH HEAL Initiative. The BACPAC Research Program is a highly collaborative, patient-centric translational research program that will elucidate mechanisms of chronic low back pain, and integrate data to identify, prioritize, and test treatments. NIH awarded 13 grants, totaling $113.6 million, towards the program in FY 2019. Additional information about BACPAC as well as other aspects of the NIH HEAL Initiative are elaborated in the trans-NIH Initiatives section.

Overall Budget Policy:
The FY 2021 President's Budget request for NIAMS is $568.5 million, a decrease of $56.4 million or 9.0 percent compared to the FY 2020 Enacted level. These reductions are distributed across all programmatic areas and basic, epidemiology, or clinical research.

Program Descriptions and Accomplishments

Systemic Rheumatic and Autoimmune Diseases

This program supports research to understand the molecular mechanisms of systemic rheumatic and autoimmune diseases and develop personalized approaches to improve patient outcomes. An important focus of the program is understanding autoantibodies— proteins produced by the immune system that contribute to autoimmune disease. In FY 2019, data from a NIAMS-funded study showed that scleroderma patients with specific autoantibodies have a higher risk of cancer than the general population whereas those with other autoantibodies have a decreased cancer risk. The study suggests that information about autoantibodies, when combined with knowledge of a patient's scleroderma subtype, could be used to improve cancer screening in people with the disease. Future research will investigate the links between autoantibodies, scleroderma, and cancer.

Other investigators supported by this program have shed light on health problems that can occur in lupus patients. One study identified a unique subset of immune cells in the blood and kidneys of lupus patients who develop a serious form of kidney disease. Researchers hope this knowledge will help identify patients with the condition to allow earlier intervention and will facilitate development of more effective therapies to treat it. Another study focused on damage to the brain in lupus, which can lead to cognitive impairment, such as memory loss and confusion. Researchers showed that ACE inhibitors, drugs that are already in wide use for treatment of high blood pressure, preserve cognitive function in a mouse model of lupus. This

discovery provides a potential new approach to manage neural complications of lupus disease. A third NIAMS-supported project found that people with lupus are at increased risk of developing a difficult to control form of high blood pressure, a known cardiovascular disease risk factor. This finding provides important information for clinicians managing these patients.

Budget Policy:
The FY 2021 budget estimate for this program is $96.8 million, a decrease of $10.1 million or 9.4 percent compared to the FY 2020 Enacted level. Program plans for FY 2021 include a re-issue of the Resource-based Centers for Rheumatic Diseases Research. The centers promote cooperative interaction between basic and clinical rheumatic diseases investigators and improve access to critical infrastructure, facilities, and services for investigators in this field. The Institute also will continue support for Centers of Research Translation in rheumatic diseases. The currently funded centers are exploring molecular mechanisms of gout, investigating how lupus begins and progresses, and developing biomarkers to detect potential lung and skin complications in patients with scleroderma.

Skin Biology and Diseases
This program seeks to understand the developmental and molecular biology of skin, the skin as an immune organ, and the genetics of skin diseases. It also supports research to understand how the skin heals after injury and use this knowledge to develop therapies to improve wound healing. Surgeons have long observed that skin wounds heal with less scarring in elderly individuals than in younger patients. A NIAMS-funded study of the effects of age on wound healing in the skin also demonstrated that the skin of older mice heals with less scarring and more normal skin function than the skin of younger mice. The investigators identified a secreted factor in young mice that may impair wound healing. This discovery may provide a potential therapeutic target for treatment of scar-related illness, not just in skin but in other organs as well. Another wound healing study by a different group characterized skin myofibroblasts, the cells responsible for skin wound healing, to identify the biological mechanisms that control them. The researchers found that specific immune cells stimulate the proliferation of a subset of myofibroblasts that contribute to wound healing. Targeting these immune cells may provide a stepping stone towards therapeutic strategies that enhance wound healing.

A growing area of interest for this program is the role of neurosensory signals in the skin. In a mouse model of psoriasis, researchers funded by the NIAMS found that perturbing the function of a specific set of sensory cells triggered itching in the mice. Previously, itch in inflammatory skin diseases such as psoriasis was generally thought to arise exclusively as a result of abnormal changes to the immune system. These findings demonstrate that neurological causes should be considered along with the immunological origins when choosing treatments for itch in skin inflammatory diseases.

Budget Policy:
The FY 2021 budget estimate for this program is $92.8 million, a decrease of $9.7 million or 9.4 percent compared to the FY 2020 enacted level. Program plans for FY 2021 include continued

support for the development and testing of interventions to improve care for atopic dermatitis. For example, the Institute will continue funding a clinical trial to determine whether an online, team-based connected health model, compared to traditional in-person care for management of atopic dermatitis, can improve access to specialists while providing equivalent reductions in disease severity. Another study will continue to test whether beginning therapy with skin-barrier-protecting emollient lotions for infants during the first two months of life can prevent the development of atopic dermatitis at two years of age.

Muscle Biology and Diseases

This program's overarching objective is to explain muscle's role in health and, ultimately, to treat or prevent skeletal muscle diseases and disorders such as the muscular dystrophies, muscle ion channel diseases, inflammatory myopathies, disuse atrophy, skeletal muscle injury, and loss of muscle mass and strength associated with aging and diseases. As preclinical translational findings make their way into clinical trials (see Director's Overview), recent basic research from this program continues to provide insights into how muscle develops, functions, and repairs itself. One study published in FY 2019 identified an unexpected connection with non-muscle diseases. Investigators discovered that protein accumulations called amyloid plaques, similar to those found in the brains of people with Alzheimer's disease, also occur in muscle where they play an important role in regeneration. This work demonstrates how a pathological structure in one disease or condition may serve a critical normal function in another organ and opens the door to new understanding to treat amyloid-associated degenerative diseases.

Budget Policy:

The FY 2021 budget estimate for this program is $70.5 million, a decrease of $7.3 million or 9.4 percent compared to the FY 2020 enacted level. Program plans for FY 2021 include support for two Senator Paul D. Wellstone Muscular Dystrophy Research Centers that promote collaborative basic, translational and clinical research and provide important resources that can be used by muscular dystrophy researchers nationwide. NIAMS also will continue to support a center of research translation dedicated to enhancing the application of basic science discoveries into genetic therapies for muscular dystrophies, such as DMD, FSHD, and others.

Joint Biology and Diseases and Orthopaedics

This program focuses on understanding the fundamental biology of tissues that comprise the joints and on applying this knowledge to a variety of diseases and orthopaedic conditions. The portfolio covers research into causes and treatments for chronic back and neck pain, prevention and repair strategies for joint injuries or joint diseases, and the development and application of imaging tools for monitoring osteoarthritis progression. Some recent NIAMS-supported research has immediate applications for our Nation's health. For example, investigators have demonstrated that an hour of moderate-to-vigorous activity a week (i.e., less than 10 minutes a day) is enough to stave off walking-related disability in older adults. Other research efforts may take years to develop into clinical applications but are providing important insights into biological functions. For example, ongoing research is finding ways to increase the nutrient supply to a structure in the spine known as the intervertebral disc (IVD). Damage to the IVD is a

frequent cause of low back pain and nutrient delivery is a crucial aspect of successful repair techniques.

Budget Policy:
The FY 2021 budget estimate for this program is $138.0 million, a decrease of $14.3 million or 9.4 percent compared to the FY 2020 enacted level. Looking to FY 2021, this program will maintain its clinical research portfolio by including projects that are examining treatments for a range of orthopaedic conditions, such as those affecting the knees and elbows. Other large ongoing projects include centers that connect musculoskeletal biology researchers with other experts who develop advanced investigational tools and methods, analyze clinical data, and actively treat patients; support the development, implementation and evaluation of animal models for musculoskeletal biology and medicine; improve clinical studies through rigorous and novel study designs, pragmatic clinical trials, and use of electronic medical records; and develop tailored assessments and interventions that reflect an individual's emotional well-being and physical function.

Bone Biology and Diseases
This program supports projects ranging from fundamental research into the genetic and cellular mechanisms involved in the build-up and breakdown of bone to epidemiologic studies of lifestyle factors that can preserve bone health. It encompasses common diseases such as osteoporosis, which affects millions of Americans, as well as conditions that occur in only a few families worldwide. For example, a recent study supported by NIAMS revealed a new way that a genetic mutation can change the behavior of small regulatory RNA fragments and cause disease—in this case, a rare bone disorder. Instead of knocking out or enhancing the functions of the RNA, this mutation causes the fragments to take on entirely new properties which led to the skeletal defects characterizing the disease. This basic research finding has implications both for the people affected by the disease and for scientific investigations into other diseases attributed to regulatory RNA molecules. Of note, this work was supported by an award issued through the NIAMS STAR program (discussed above) that assists promising investigators expand their laboratories' research capacity.

Budget Policy:
The FY 2021 budget estimate for this program is $77.6 million, a decrease of $8.1 million or 9.4 percent compared to the FY 2020 enacted level. Looking to the future, NIAMS will continue to support implementation of research recommendations from the Pathways to Prevention workshop on Appropriate Use of Drug Therapies for Osteoporotic Fracture Prevention, which NIAMS, the National Institute on Aging, and the NIH Office of Disease Prevention sponsored in FY 2019. Other plans for FY 2021 include ongoing support for two center grants, one of which is fostering interdisciplinary bone research among investigators across the New England region and one that is linking researchers with state-of-the-art resources to identify targets for diagnosis and treatment of skeletal disorders.

Intramural Research Program (IRP)

NIAMS' IRP conducts innovative basic, translational, and clinical research relevant to the NIAMS mission and trains investigators who are interested in related careers. Its basic researchers and physician-scientists study the genetics, etiology, pathogenesis, and treatment of rheumatic, autoimmune, inflammatory, bone, skin, and muscle diseases. For example, NIAMS intramural scientists are working to understand why oral wounds heal quicker than wounds on the skin. Recently, basic research efforts identified several molecular signatures that correspond with distinct stages of healing, and demonstrated the oral mucosa is primed for rapid repair even before a wound occurs. This knowledge may inform the development of better therapeutic strategies for skin wounds, such as non-healing foot sores associated with diabetes. Other researchers are examining how the skin microbial populations (microbiome) of patients with a rare immune disorder are different from normal individuals. They revealed that the patients' skin microbial populations were rich in viruses, including human papillomaviruses, even when there were no clinically apparent skin lesions, such as warts. The study provides a unique perspective on how a person's genetic makeup may alter their immunity and shape their microbiome, and how, in return, the microbiome may interact with a person's immune system to drive disease. Finally, NIAMS intramural researchers are continuing to build and improve our understanding of the mechanisms the immune system uses to respond to various infections. Recent work found that a molecule called CGRP is produced by certain immune cells during parasitic worm infections and acts to suppress inflammation and slow worm clearance. Interestingly, CGRP is also secreted by neurons and has been associated with migraines. It could be envisioned that CGRP-blocking drugs, such as some currently in development to treat migraines, could also aid in clearance of worm infections, a significant public health risk especially in developing nations. Alternatively, novel therapeutics that enhance CGRP signals could potentially modulate inflammatory responses, such as those in allergy and asthma.

Program Portrait: NIAMS Scholars in Translational Research

One key focus of the intramural research program is a strong commitment to the development of the next generation of researchers. At NIAMS, the Career Development and Outreach Branch (CDOB) is responsible for managing and enriching the overall research training experiences of trainees at all educational levels, attracting the best trainees and providing them with a genuine growth experience, thus enhancing their ability to compete for independent research careers within and outside the NIH. The Scholars in Translational Research program is one part of the NIAMS IRP's commitment to train the next generation researchers, specifically the future physician-scientist leaders in rheumatology, dermatology, and related clinical research. The Scholars Program is designed to prepare candidates for tenure-track faculty positions in the extramural community or within the NIH intramural program.

The Scholars in Translational Research began in FY 2009 with two programs; the Metzger Scholars Program, named for Henry Metzger, M.D., a distinguished immunologist and the first Scientific Director of Intramural Research at the NIAMS, for those pursuing primarily lab-based rheumatology research; and the Shulman Scholars Program, named for Lawrence E. Shulman, M.D., Ph.D., the first Director of the NIAMS and a noted clinician-investigator, for those pursuing primarily clinically-based rheumatology research. In FY 2019, NIAMS expanded to include the Katz Scholars Program targeted to dermatologists pursuing advanced research training in the Dermatology Branch, and named in honor of the late Stephen I. Katz, M.D., Ph.D., the renowned dermatologist and immunologist, former Dermatology Branch Chief, and long-standing NIAMS Director.

Since its inception, the Scholars programs have recruited 20 outstanding physician-scientist fellows to receive advanced training in rheumatology and related fields in genetics, immunology and inflammation biology. The programs have provided a successful bridge for these advanced trainees, a majority of whom have already progressed to independently-funded positions at the NIH, other academic medical centers, or industry.

Budget Policy:
The FY 2021 budget estimate for this program is $59.8 million, a decrease of $5.2 million or 8.0 percent compared to the FY 2020 enacted level. Program plans for FY 2021 include continued support for basic and clinical investigations into the causes and treatment of rheumatic, skin, muscular and inflammatory diseases. For example, the Lupus Clinical Trials Unit (LCTU) recently celebrated the 25th anniversary of the *Systemic Lupus Erythematosus Natural History and Pathogenesis* protocol. This important resource has helped to better characterize the variability of lupus and continues to provide biological specimens and outstanding clinical characterization of patients for intramural and extramural labs. The LCTU will continue to develop and implement clinical research protocols and conduct high impact, innovative clinical research into the causes, treatment, and prevention of lupus.

Research Management and Support (RMS)
The RMS budget supports the scientific, administrative management, and information technology activities associated with the NIAMS' day-to-day operations. In FY 2019, NIAMS managed 1,086 research grants and centers, as well as 41 research and development contracts and 278 individual and institutional full-time research training positions. NIAMS supported 591 clinical research studies, including 88 clinical trials. In FY 2019, NIAMS engaged with researchers, healthcare professionals, and health advocacy organizations to develop a new Strategic Plan from FY 2020-2024. The Plan conveys both the tremendous potential of current research endeavors and the Institute's aspirational vision for how work over the next five years may lead to meaningful improvements to human health. It features new sections devoted to four broad cross-cutting scientific themes that acknowledge the increasing convergence of scientific knowledge and approaches across fields, which represents an unprecedented opportunity to invigorate the conduct of science. The Plan also specifically elaborates NIAMS's long-standing commitment to responsible management and stewardship of public resources in a dedicated section.

Budget Policy:
The FY 2021 budget estimate for this program is $33.0 million, a decrease of $1.7 million or 5.0 percent compared to the FY 2020 enacted level. Program plans include continued support of scientific planning and implementation efforts through the facilitation of scientific roundtable meetings. Potential meetings during FY 2020 include topics such as improving clinical trial design to be able to identify whom to treat, with which interventions, for how long – the ultimate goal in personalized medical treatment – as well as gathering lessons learned from large, NIH-facilitated team-science partnership efforts (e.g., the Accelerating Medicines Partnership in Rheumatoid Arthritis and Lupus). These and other scientific roundtable discussions will inform program efforts in FY 2021 and beyond.

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Budget Authority by Object Class[1]

(Dollars in Thousands)

		FY 2020 Enacted	FY 2021 President's Budget	FY 2021 +/- FY 2020
Total compensable workyears:				
	Full-time equivalent	238	238	0
	Full-time equivalent of overtime and holiday hours	0	0	0
	Average ES salary	$197	$197	$0
	Average GM/GS grade	12.6	12.6	0.0
	Average GM/GS salary	$122	$123	$1
	Average salary, grade established by act of July 1, 1944 (42 U.S.C. 207)	$105	$108	$3
	Average salary of ungraded positions	$147	$148	$1
	OBJECT CLASSES	**FY 2020 Enacted**	**FY 2021 President's Budget**	**FY 2021 +/- FY 2020**
	Personnel Compensation			
11.1	Full-Time Permanent	16,488	16,677	190
11.3	Other Than Full-Time Permanent	9,944	10,058	114
11.5	Other Personnel Compensation	856	866	10
11.7	Military Personnel	368	378	10
11.8	Special Personnel Services Payments	2,821	2,853	32
11.9	**Subtotal Personnel Compensation**	**$30,477**	**$30,833**	**$356**
12.1	Civilian Personnel Benefits	9,648	10,025	376
12.2	Military Personnel Benefits	214	219	6
13.0	Benefits to Former Personnel	0	0	0
	Subtotal Pay Costs	**$40,338**	**$41,076**	**$738**
21.0	Travel & Transportation of Persons	693	530	-163
22.0	Transportation of Things	104	79	-24
23.1	Rental Payments to GSA	0	0	0
23.2	Rental Payments to Others	0	0	0
23.3	Communications, Utilities & Misc. Charges	700	684	-16
24.0	Printing & Reproduction	0	0	0
25.1	Consulting Services	1,518	1,251	-267
25.2	Other Services	6,457	5,478	-979
25.3	Purchase of goods and services from government accounts	58,912	58,135	-777
25.4	Operation & Maintenance of Facilities	41	38	-3
25.5	R&D Contracts	5,036	4,429	-607
25.6	Medical Care	5,104	3,581	-1,522
25.7	Operation & Maintenance of Equipment	1,306	924	-382
25.8	Subsistence & Support of Persons	9	7	-2
25.0	**Subtotal Other Contractual Services**	**$78,384**	**$73,843**	**-$4,540**
26.0	Supplies & Materials	4,793	3,002	-1,791
31.0	Equipment	3,046	1,903	-1,143
32.0	Land and Structures	0	0	0
33.0	Investments & Loans	0	0	0
41.0	Grants, Subsidies & Contributions	496,831	447,362	-49,469
42.0	Insurance Claims & Indemnities	0	0	0
43.0	Interest & Dividends	0	0	0
44.0	Refunds	0	0	0
	Subtotal Non-Pay Costs	**$584,551**	**$527,404**	**-$57,147**
	Total Budget Authority by Object Class	**$624,889**	**$568,480**	**-$56,409**

[1] Includes FTEs whose payroll obligations are supported by the NIH Common Fund.

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Salaries and Expenses

(Dollars in Thousands)

OBJECT CLASSES	FY 2020 Enacted	FY 2021 President's Budget	FY 2021 +/- FY 2020
Personnel Compensation			
Full-Time Permanent (11.1)	$16,488	$16,677	$190
Other Than Full-Time Permanent (11.3)	9,944	10,058	114
Other Personnel Compensation (11.5)	856	866	10
Military Personnel (11.7)	368	378	10
Special Personnel Services Payments (11.8)	2,821	2,853	32
Subtotal Personnel Compensation (11.9)	**$30,477**	**$30,833**	**$356**
Civilian Personnel Benefits (12.1)	$9,648	$10,025	$376
Military Personnel Benefits (12.2)	214	219	6
Benefits to Former Personnel (13.0)	0	0	0
Subtotal Pay Costs	**$40,338**	**$41,076**	**$738**
Travel & Transportation of Persons (21.0)	$693	$530	-$163
Transportation of Things (22.0)	104	79	-24
Rental Payments to Others (23.2)	0	0	0
Communications, Utilities & Misc. Charges (23.3)	700	684	-16
Printing & Reproduction (24.0)	0	0	0
Other Contractual Services:			
Consultant Services (25.1)	1,518	1,251	-267
Other Services (25.2)	6,457	5,478	-979
Purchases from government accounts (25.3)	39,443	37,867	-1,577
Operation & Maintenance of Facilities (25.4)	41	38	-3
Operation & Maintenance of Equipment (25.7)	1,306	924	-382
Subsistence & Support of Persons (25.8)	9	7	-2
Subtotal Other Contractual Services	**$48,774**	**$45,565**	**-$3,210**
Supplies & Materials (26.0)	$4,793	$3,002	-$1,791
Subtotal Non-Pay Costs	**$55,064**	**$49,860**	**-$5,204**
Total Administrative Costs	**$95,403**	**$90,936**	**-$4,466**

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Detail of Full-Time Equivalent Employment (FTE)

OFFICE/DIVISION	FY 2019 Final			FY 2020 Enacted			FY 2021 President's Budget		
	Civilian	Military	Total	Civilian	Military	Total	Civilian	Military	Total
Division of Extramural Research									
Direct:	47	1	48	47	1	48	47	1	48
Reimbursable:	-	-	-	-	-	-	-	-	-
Total:	47	1	48	47	1	48	47	1	48
Intramural Research Program									
Direct:	115	1	116	135	2	137	135	2	137
Reimbursable:	1	-	1	1	-	1	1	-	1
Total:	116	1	117	136	2	138	136	2	138
Office of the Director									
Direct:	52	-	52	52	-	52	52	-	52
Reimbursable:	-	-	-	-	-	-	-	-	-
Total:	52	-	52	52	-	52	52	-	52
Total	215	2	217	235	3	238	235	3	238
Includes FTEs whose payroll obligations are supported by the NIH Common Fund.									
FTEs supported by funds from Cooperative Research and Development Agreements.	0	0	0	0	0	0	0	0	0
FISCAL YEAR	**Average GS Grade**								
2017	12.5								
2018	12.6								
2019	12.6								
2020	12.6								
2021	12.6								

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Detail of Positions[1]

GRADE	FY 2019 Final	FY 2020 Enacted	FY 2021 President's Budget
Total, ES Positions	0	1	1
Total, ES Salary	0	197,300	197,300
GM/GS-15	26	27	27
GM/GS-14	27	28	28
GM/GS-13	56	58	58
GS-12	19	21	21
GS-11	10	12	12
GS-10	0	0	0
GS-9	4	4	4
GS-8	3	3	3
GS-7	4	4	4
GS-6	2	2	2
GS-5	1	1	1
GS-4	1	1	1
GS-3	1	1	1
GS-2	0	0	0
GS-1	0	0	0
Subtotal	154	162	162
Grades established by Act of July 1, 1944 (42 U.S.C. 207)			
Assistant Surgeon General	0	0	0
Director Grade	0	0	0
Senior Grade	1	2	2
Full Grade	1	1	1
Senior Assistant Grade	0	0	0
Assistant Grade	0	0	0
Subtotal	2	3	3
Ungraded	75	86	86
Total permanent positions	153	163	163
Total positions, end of year	231	252	252
Total full-time equivalent (FTE) employment, end of year	217	238	238
Average ES salary	0	197,300	197,300
Average GM/GS grade	12.6	12.6	12.6
Average GM/GS salary	117,544	121,642	122,899

[1] Includes FTEs whose payroll obligations are supported by the NIH Common Fund.